

## **CHIEF ENGINEER'S CORNER**

### **Aerospace Hosts AF-Contractor Team**

Dr Joe Meltzer and Col Chuck Whited

An Air Force-Contractor Team meeting for the SMC Manufacturing Problem Prevention Program (MP3) was held with attendees including virtually all Air Force Space Systems contractors. The meeting focused on the growing need to ensure the performance of space systems equipment after extended periods of ground storage. As space systems have demonstrated longer orbital operating capabilities, more and more equipment is being placed into storage until needed.

### **Focus on Aging/Storage and Surveillance of Space Systems**

George Epstein

The Aerospace Corp. was the host for the Team meeting. Organizers were Mr. Theodore Krawczyk (SMC/AXME), Jerry Bauer and Ken Drake of the Vehicle Design and Manufacturing Dept., Dr. Howard Katzman of the Mechanics and Materials Technology Center, and George Epstein of The Aerospace Institute.

In opening the two-day meeting, Col. C. Whited, SMC Chief Engineer, and Dr. Joseph Meltzer, Aerospace Corp. Chief Engineer, stressed the importance of industry and Air Force cooperative efforts to achieve the Air Force space mission and the need to avoid costly anomalies through programs such as the MP3. George Epstein provided a background of the MP3, starting in 1980. A number of strategies have been issued covering recurring manufacturing-related anomalies that have had significant impact. The Chief Engineer's Office plans to publish these in its World Wide Web page. For example, Epstein presented an analysis of the cost avoidance (savings) of over \$80 million when Lockheed Martin implemented one of these strategies. The MP3 has evolved to include not only current but anticipated industry issues and concerns as well -- such as the effects of aging on space systems and the materials used in manufacturing them.

- Storage/Surveillance of Space Systems

Industry briefings described the approaches being taken for storage of GPS, DMSP, GOES, DSP, Titan IV, SRMU, and IUS hardware. In every case, the objective is to ensure performance following extended periods of ground storage. Various storage environments are used, generally controlling humidity and temperature; although, there are distinct differences depending on the particular contractor, and system-unique requirements. (This suggests the need for SMC to establish a standardized protocol for storage/surveillance of its equipment.) Certain types of equipment require special attention, such as lubricated systems, batteries and propulsion devices. (There appears to be differences of opinion on the best way to ensure long-term effectiveness of lubricated systems.) Understandably, past designs generally did not consider the need for storage; thus some key components are not readily accessible for testing during storage. (New contracts should include the requirement to design for storage.) In many cases, data is simply lacking to permit the contractors to define the proper storage conditions.

- Laboratory Studies at The Aerospace Corp.

Anticipating this need, three years ago, the Aerospace Corp's Chief Engineer's Office initiated extensive laboratory studies in the Mechanics and Materials Technology Center. These studies were briefed by the responsible laboratory personnel: Stress relaxation of spring materials (W. D. Hanna); Migration of chemical constituents in solid-propellant-motor liner system (M. P. Easton); Cracking susceptibility of solid-rocket-motor bondline primer (Dr. C.S. Heminger); Aging of polymer/metal interfaces - metallized thermal control films (Dr. C.S. Heminger); Atmospheric degradation of solid lubricants (Dr. J.R. Lince); Storage of liquid-lubricated components (Dr. P.A. Bertrand); Effects of storage on dimensional stability of composites (Dr. T.D. Le); Electrically conductive adhesives (prepared by Dr. T.W. Giants -- presented by Dr.

Howard Katzman); and Plans for investigating the long-term storage of the Teal Ruby satellite (Dr. H. Katzman).

Following these presentations, the attendees were provided a tour of the Aerospace Corp. laboratories to observe where these studies were being conducted and to further discuss details.

The meeting also provided information on aging/storage issues related to fiber-reinforced prepreg materials (used extensively in satellite and launch vehicle structures) and O-rings (especially compression-set characteristics which can degrade sealing effectiveness).

The Air Force Materials Directorate briefed the Team on its current efforts and plans for supporting increasing Air Force needs for use of aged equipment. Considerable resources have been devoted to the aging aircraft program and will be applied to space and missile systems, according to Mr. Gary Waggoner, Chief of the Systems Support Division in the Materials Directorate at Wright-Patterson AFB. Heat shields using rayon-based carbon-phenolic materials, are a special concern for reentry vehicles; an extensive study is planned starting this year. Also representing the Air Force Materials Directorate, Bryan C. Foss briefed the team on its programs for nondestructive evaluation (NDE) of space systems hardware; and he requested the Team's help in identifying needs so that the Air Force laboratory efforts could be better focused.

- Future Plans

As the final item of business, the AF-Contractor Team reviewed the problems and issues that had been identified by the Team three years ago. The issues related to replacement of Ozone-Depleting Compounds remains a high-priority concern, including how to best meet government regulations in the factory and dealing with government constraints. This will be a focus of the next Team meeting, tentatively scheduled for the

Spring of '97 at The Aerospace Corp. Issues related to government/military specifications also remain high on the list of industry concerns.

With increasing need for storage of equipment and concomitant aging issues, the Team strongly recommended another meeting in one year to focus on this topic. At that time, considerable data should be available from a number of the storage/surveillance programs now underway or planned, as well as the Aerospace Corp. laboratory studies that are continuing. In addition, the meeting should provide information on accelerated aging of materials and components, deemed important to permit prediction of aging effects and possible changes in design and/or storage conditions as well as an update of the Teal Ruby satellite investigation.